

REMARKS

Claims 1-8, 11-14, and 16 were rejected for imparticularity. Applicant requests reconsideration. The term "asynchronous" has been removed from the claims. Applicant disagrees that the specification did not teach asynchronous communications. However, the claims have been amended using language found in the specification.

Claims 1 and 8 were rejected as unpatentable over Beauducel in view of Palmer. Claims 2-4 and 11 were rejected as unpatentable over Beauducel in view of Palmer in view of Potratz. Claim 5 was rejected as unpatentable over Beauducel in view of Palmer in view of Scott. Claims 6-7 were rejected as unpatentable over Beauducel in view of AAPA. Applicant requests reconsideration.

Perhaps a simple specific example would be helpful for improved understanding. When the analog input is zero volts, for example, between a maximum positive voltage and a minimum negative voltage, the output of the pulse phase modulator provides a square wave have a 50% duty cycle having a predetermined period. When the analog input voltage is positive, for example, +1V, the duty cycle is increased where the laser pulse is on more than off, for example, with a 60% duty cycle. That is, pulse width was modulated to having an increased duty cycle. When the analog input voltage is negative, for example, -1V, the duty cycle is decreased where the laser pulse is off more than on, for example, with a 40% duty cycle of the period. That is, the pulse width was modulated to have a decreased duty cycle. In all such cases, the time period of the pulse indicates the analog voltage. In the receiver, the positive portions of the duty cycle are detected by the pulse width detector

1 providing a binary detection signal having the same duty cycle. The
2 binary detection signal is then converted into symbols of +1 and -
3 1, that could be, for example, +1V and -1V, indicating a binary
4 symbol set also having the same duty cycle. The digital filter, in
5 the preferred form, samples the stream of symbols to provide a
6 digital word at the digital output. This is best understood,
7 perhaps, by realizing that the value of the digital output signal
8 increases and decreases as the duty cycle of the symbol stream
9 increases and decreases. This can be implemented by digital filter
10 in many ways. One way would be to time average the symbols of a
11 symbol stream having a modulated duty cycle between a binary set of
12 symbols +1 and -1. At the 50% duty cycle, for example, when the
13 analog voltage is zero, the average value of the symbol stream
14 would also be zero. That is, the digital output would be a zero
15 value being a time average of the 50% duty cycle of the +1 and -1
16 symbols when the analog input is 0V. The digital output signal is a
17 digital value indicating the analog input. As the analog input
18 increases and decreases, the duty cycle increases and decreases and
19 the digital word value increases and decreases. The communication
20 is asynchronous without frame words and correction codes. The
21 communication does not need to rely upon accurate tracking of the
22 period of the symbol stream because the digital filter can be
23 merely activated and clocked by the timing recovery loop without
24 precise coherent tracking. The timing recovery loop need not
25 coherently and precisely track transitions of the symbol stream,
26 but merely provide an activation clocking signal because the
27 digital output signal is a time average of the symbol stream as a
28 digital filter filtering samples of the symbols stream over time.

1 The digital filter preferably averages a plurality of symbols.
2 However, even one isolated pulse could be measured by the simply
3 counting clock tics while the symbol output is +1.

4 The specification teaches in the background: 1) The
5 synchronization is achieved during removal of the frame
6 synchronization words; 2) These synchronization frames words are
7 overhead data and are typically one to ten percent of the
8 informational data words; 3) To accomplish the communications at
9 the original data bit, the serial stream including the frame words
10 and redundant error correction bits must be reclocked to a higher
11 data rate having a shorter bit duration time; 4) In order to
12 maintain data rate of the data words when the serial bit stream has
13 additional synchronization frame words, the serial bit stream will
14 be clocked at a higher rate; 5) The received data stream must also
15 therefore be reclocked to recover the original data; 6) Frame
16 synchronization is performed to determine the significance of the
17 bits during which the frame synchronization words are removed from
18 the data stream and the data is reclocked into a serial bit stream
19 having a bit time duration equal to the bit time during the serial
20 data stream prior to frame synchronization in the transmitter; 7)
21 The serial data stream is then converted back into the original n
22 bit parallel data words by sampling the serial data stream at the
23 bit time duration and clocking the serial bit stream into a serial
24 to parallel converter..

25 The background teaches the problems of synchronous
26 communications using frame words and error correcting codes and the
27 problem of coherent reception characterized by reclocking. The
28 problems of synchronous communications including reclocking are

1 solved by the present invention. The specification teaches the
2 solution to the unwanted use of frame words, error correcting
3 codes, and coherent tracking and reclocking. The digital filter and
4 timing recovery loop can provide noncoherent reception where the
5 timing recovery loop does not necessarily adjust sampling clocks
6 with precision to track changes in the period.

7 The specification teaches the use of digital filtering,
8 including: 8) Hence, the present invention is directed to
9 communicating in binary form an analog signal using a sigma delta
10 modulator and recovering a digital sample of the analog signal
11 using a digital filter; 9) The receiving satellite has a simple
12 digital filter detector, which determines when the received signal
13 from the laser is on or off; 10) No error correction is required
14 because redundancy is added by the over sampling of the sigma delta
15 converter; 11) No synchronization is needed between the two
16 satellites because the output of the digital filter may be sampled
17 at any time to reconstruct signal samples; 12) No framing is needed
18 in the data stream because the data stream is self-synchronizing;
19 13) Also, there is no need to order bits from most to least
20 significant bits as in traditional digital data links because only
21 the duration of the bit time is required for proper data detection;
22 14) The symbol to binary converter 42 converts analog voltages of
23 the modulated signal from the sigma delta modulator 40 into binary
24 values of on or off states; 15) The receiver 36 includes a pulse
25 width detector 46 and a binary signal to the symbol converter 40;
26 16) The receiver 36 receives the communication signal and detects
27 the laser pulse widths and outputs a digital symbol signal to a
28 timing recover loop 52 and a digital filter 50 that provides the

1 digital output 38; 17) The pulse width detector 46 in the receiver
2 detects the duration of laser pulses of the communicated signal and
3 provides binary values; 18) The laser pulses are received by the
4 pulse width detector 36 in the receiver 34 and outputs a binary
5 value one for the duration of the communicated laser pulse; 19) The
6 binary to symbol converter 48 changes the binary output 0 or 1 from
7 the detector 36 into +/-1 output symbols; 20) The digital filter 50
8 is a circuit that filters the binary symbols signal and provides
9 the digital output signal clocked by the timing recover loop 52;
10 21) The timing recovery loop 52 recovers from the symbol output a
11 sample rate to provide a clock signal to the digital filter 50 for
12 clocking the digital output signal 38; 22) The digital output 38 is
13 an n bit digital sample of the analog input dependant upon the
14 length and word size of the digital filter; 23) The laser
15 communication crosslink system need not use parallel to serial
16 conversion, frame synchronization, data reclocking, or forward
17 error correction; and 24) The laser pulses are communicated over
18 the communications medium 34 as the communications signal.

19 From these teachings, it is abundantly clear that the modulated
20 binary laser signal includes a pulse having a pulse width that is
21 detected upon reception. The pulse does not include therein
22 transitions between the start and stop of the pulse. The phrase
23 self-synchronizing was used to indicate that the no other form of
24 synchronization was used, such as frames, ECC, or transitions
25 within the pulses for coherent reception. No local oscillator is
26 used for determining the pulse width from transitions within the
27 pulse width to derive a coherent clock signal for precise tracking
28 transition time shifts for precise sampling the received signal.

1 Rather, digital filtering is used to translate the symbol stream
2 into the digital output signal.

3 Beauducel solved the problem of communicating a clocked laser
4 signal using a synchronous demodulation by "transmitting from each
5 of the local modulators to the remote station a clock signal
6 allowing a synchronization of the remote station with each local
7 modulator". (See claim 1) Beauducel could have used a local
8 oscillator at the remote station for coherent reception, but more
9 simplistically routed a separate hard-wired clock to enable
10 clocking at the remote station. The hard-wired clock is perfectly
11 matched in synchronism to the synchronization element driving the
12 sigma modulator so that the communication is precisely synchronous.
13 The present invention does not use direct hard-wired clocking. The
14 present invention does not require coherent reception. Beauducel
15 preferably uses hard-wired clocking synchronization for the
16 required clocking synchronization. The present invention does not
17 require synchronization. The detector merely detects the pulse
18 width without regard to any synchronization, and is thereby "self-
19 synchronizing".

20 Palmer teaches mixing the signal with a clock signal to
21 provide a clocked transmitted signal. This clock signal has
22 internal transitions that can be detected upon reception and used
23 to adjust a local oscillator upon reception using coherent
24 reception that requires some kind of clocking transitions. The
25 communicated laser pulse of the present invention has a
26 predetermined pulse width indicating the analog value. The pulse
27 having that pulse width indicating the analog value would no longer
28 be a pulse width indicating the analog value if the pulse width is

1 destroyed with internal transitions, as then the pulse width would
2 comprise smaller pulse widths separated by transitions.

3 Palmer specifically teaches that the receiver 58 detects the
4 modulated laser beam using a photonic detector 40. Following
5 detection, the signal is still modulated by the original clock
6 signal from the VCO 26. A notch filter 46 is used to recover the
7 clock. The recovered clock is mixed with the received signal for
8 recovering the received signal.

9 Palmer, like Beauducel, used synchronous communication using
10 a clock signal, either separately as preferably in Beauducel, or
11 embedded as preferably in Palmer. The laser pulse of the present
12 invention does not use a clock signal at all. Rather, only pulse
13 width is used to generate a symbol that is filtered into the
14 digital output. The receiver, tracking loop, and digital filter
15 need not be synchronous or coherent. The present invention is
16 characterized by detecting, that is measuring, the pulse width that
17 directly relates to the analog value. At the point of novelty, the
18 examination states Beauducel teaches at Col. 3 lines 59-62 that the
19 claim limitation of "the modulated binary laser signal having a
20 pulse width having a duration representative of the analog input
21 signal (inherent in modulation)". If the pulse width is inherently
22 modulated, then pulse width is no longer a pulse width, but an
23 inherently modulated one. The modulation of the prior art is for
24 purposes of synchronizing the communication. The waveform is
25 modulated so that the receiver locks onto the modulation to
26 recovery the modulation timing for improved sampling. The
27 modulation of the present invention is for purposes of
28 communicating information content.

1 Beauducel teaches both synchronization and non-binary tri-
2 state coding, as specifically described at Col. 3 lines 45-62. The
3 import of the words "applying a predetermined coding allowing a
4 clock signal to be conveyed at the same time as the signals, such
5 as the HDB3 code, a multi-level code, the CMI-3 code suited to an
6 optical type transmission, etc". Here, Beauducel is teaching that
7 the transmitted signal is encoded with a clock prior to
8 transmission, and is not simply an on and off binary signal having
9 a pulse width that is asynchronously communicated. The receiver
10 must further have a decoding circuit as taught at Col. 3 lines 63
11 to Col. 4 line 6. There is a difference between modulating the
12 analog input signal into a binary signal having a pulse width that
13 is modulated in horizontal length so as to represent the analog
14 value by virtue of that horizontal length, versus modulating the
15 signal as to its height so as to encode and embed synchronous
16 clocking signals and transitions for synchronous communications.
17 These two types of modulations are different yet both characterized
18 as "modulations", and this may be confusing to one unskilled in the
19 art.

20
21 Claim 1 of Beauducel states, "transmitting for each local
22 modulator to the remote station a clock signal allowing a
23 synchronization of the remote station with each local modulator".
24 Continuing in claim 2, Beauducel states "transmitting the clock
25 signal with each bit stream by coding each bit stream with the
26 clock signal". Beauducel teaches and claims encoding the
27 communicated signal with a clock for synchronized communications,
28 the very problem that the present invention solves.

1 Palmer teaches using sigma delta modulators for use in a laser
2 communication system for transmitting synchronized digital signals.
3 Beauducel teaches generating synchronized and non-binary coded
4 signals. The cited references do not suggest a solution to
5 transmitting an analog value, that is, information content,
6 asynchronously using in a laser binary signal having a modulated
7 pulse width representing that analog value. The cited references do
8 teach nor suggest pulse width modulation for indicating an analog
9 input, binary laser modulation upon transmission, binary detection,
10 binary to symbol conversion, and digital filtering upon the symbols
11 to provide a digital output indicating the analog input value.
12 Allowance of the claims is requested.

13
14 Respectfully Submitted

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